

# A Game-Theoretic Analysis of China's WTO Accession

by

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## Abstract

This paper studies the determination of split of gains among the negotiating parties (member countries and the acceding country) in a WTO accession negotiation using a sequential bargaining model. In particular, we are interested in the effect of the most-favored-nation (MFN) principle on the negotiation outcome. The MFN principle says that any tariff reduction offered by the applicant for accession has to be automatically granted to all existing members. This implies that any deal that an applicant, such as China, makes with a member can be made more unfavorable to China in subsequent negotiations. On the other hand, since China has the foresight that giving up each dollar to one country means giving up many more dollars, this would harden China's bargaining position. Resorting to intuition alone, therefore, it is not clear whether China would benefit or be disadvantaged by the existence of MFN. Using the model, however, we find unambiguously that China's share of surplus is more when MFN is in place.

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# A Game-Theoretic Analysis of China's WTO Accession

## 1 Introduction

This paper studies the determination of the efficiency of the negotiated tariffs and the split of surplus among the negotiating parties (member countries and the acceding country) in a WTO accession negotiation. In particular, we are interested in the effect of the most-favored-nation (MFN) principle on the negotiation outcome. According to the rules of the WTO, when a non-member applies for accession, it has to first propose a set of tariff reductions to all members of the Working Party, which consists of all the interested members of the WTO. These countries usually include all the large trading countries in the WTO. After that, the applicant has to conduct a series of bilateral market-access negotiations with each member of the Working Party. Normally, the tariff commitments of members would be fixed by previous rounds of WTO/GATT negotiations, and would not be altered in the accession negotiations. At the conclusion of this series of bilateral negotiations, the applicant would usually have satisfied all the members of the Working Party. (See WTO 1995a, b and 1999.) The MFN principle says that any tariff reduction or trade concessions offered by the applicant has to be automatically granted to all existing members. This implies that any deal that an applicant, such as China, makes with a member can be made more unfavorable to China by subsequent negotiations. On the other hand, since China has the foresight that giving up each dollar to one country means giving up many more dollars, this would harden China's bargaining position. It is therefore not clear whether China would benefit or be disadvantaged by the existence of MFN. Using the model, however, we find unambiguously that China's share of surplus is more under sequential negotiations with MFN in place than under sequential negotiations with no requirement for MFN.

In the following analysis, we assume there are three symmetric countries, call them the US, EU and China. The US and EU are members of WTO, while China is applying for accession to the WTO. If one examines the rules of WTO, it is not unreasonable to assume that the negotiations are sequential. Therefore, we use a sequential cooperative Nash bargaining model to study the accession negotiations. Besides concessions on tariff bindings by countries, we assume that wealth transfer is possible between countries. Wealth transfer is interpreted as concessions made in issues other than tariff negotiations (e.g. intellectual property protection). Therefore, the negotiations over wealth transfer amount to the three

countries dividing a pie of fixed size among themselves. More wealth transfer from China means that China gets a smaller slice of the pie, while the other countries get a larger slice. MFN principle implies that US and EU would obtain the same tariff concessions and wealth transfer from China at the end of the negotiations.

Although the implications of MFN and reciprocity in trade liberalization has been studied before (see, for example, Bagwell and Staiger 2001), the role of MFN in accession negotiations has not been examined in the literature. The literature most closely related to the present paper is the small literature in industrial organization on the implications of “most-favored-customer” undertaking (Cooper and Fries 1991 and Horn and Wolinsky 1988).

In section 2, we introduce the competing supplier model as the basis on which trade pattern is derived. Section 3 uses a sequential Nash bargaining model to analyze the properties of the outcome of the accession negotiation with no MFN. Section 4 examines the negotiation outcome with MFN in place, using the same modeling technique. Section 5 concludes.

## 2 The Trade Model

In this section we examine a simple three country model in which each country imports one good from each of the two other countries. This model is useful for analyzing the role played by the MFN principle in the accession process, since countries can impose different tariffs on non-member countries from those on member countries.

We assume that each country has an identical utility function  $U = \sum_{i=1}^3 (AD_i - 0.5D_i^2) + D_0$ , where  $D_i$  denotes consumption of good  $i$  and good 0 is the numeraire good. This utility function yields a demand function for the non-numeraire good  $j$  in country  $i$  of  $D_j^i = A - P_j^i$ , where  $P_j^i$  is the domestic price of good  $j$  in country  $i$ . Country  $i$  is assumed to have a fixed endowment  $x_0$  of good 0,  $y$  of good  $i$  and an endowment  $x$  (where  $x > y$ ) of non-numeraire good  $j \neq i$ . It is assumed that there is a unit transport cost  $c$  between each pair of countries for each good. Markets are perfectly competitive, as there are a large number of buyers and sellers in each market in all countries. Under these assumptions, the non-numeraire goods would each sell for a price of  $A - [2(x - c) + y]/3$  in a free trade equilibrium, with country  $i$  importing  $(x - y - c)/3$  units of good  $i$  from each of the other countries. The numeraire good will not be traded under free trade, but is introduced to serve as a means of making transfers between the countries.

We assume that country  $i$ 's only trade instrument is an import tariff. Since country  $i$  is the only importer of good  $i$  and only imposes tariffs on good  $i$ , we can drop the country superscript and let  $t_{ij}$  be the specific tariff imposed on imports of good  $i$  from country  $j$ . If  $|t_{ij} - t_{ik}| \leq c$  for  $j, k \neq i$ , then both  $j$  and  $k$  will prefer to export to country  $i$  and  $P_i^j = P_i^i - t_{ij} - c$  (and  $P_i^k = P_i^i - t_{ik} - c$ ). This condition can then be substituted into the market clearing conditions to solve for  $P_i^i$  and imports by country  $i$  from country  $j$ ,  $M_{ij}$ ,

$$P_i^i = A - \left[ \frac{2x + y - t_{ij} - t_{ik} - 2c}{3} \right]; \quad M_{ij} = \frac{x - y - 2t_{ij} + t_{ik} - c}{3} \quad (1)$$

where  $|t_{ij} - t_{ik}| \leq c$  for all  $k \neq j, i$

The expression for  $M_{ik}$  can be derived similarly. As long as  $t_{ij}$  and  $t_{ik}$  do not differ too much so that  $|t_{ij} - t_{ik}| \leq c$  is maintained, an increase in  $t_{ij}$  will improve the terms of trade of countries  $i$  and  $k$ , but will worsen the terms of trade of country  $j$ .

If  $|t_{ij} - t_{ik}| \leq c$  is violated, for example, if country  $i$  chooses  $t_{ik} > t_{ij} + c$ , the prices determined by (1) yield  $P_i^j - P_i^k > c$ . If country  $j$  does not impose a tariff on imports of good  $i$  from  $k$ , then exporters in  $k$  could earn more by selling in  $j$  than by selling in  $i$ . Commodity arbitrage would then yield  $P_i^j = P_i^i - t_{ij} - c$  and  $P_i^k = P_i^j - c$ . Note in particular that with the assumption made here on endowments, such trade would not violate any rules of origin imposed by country  $i$ , because the market in  $i$  can be satisfied by exports from  $j$ . However, in the event of such arbitrage, it can be easily shown that it would not be in the interest of country  $j$  to impose a tariff on imports of good  $i$  from  $k$ . Furthermore, it will not be in the interest of  $i$  to choose tariffs  $t_{ij}$  and  $t_{ik}$  that creates such arbitrage. Therefore, the no arbitrage condition will serve as a constraint on the tariff choice of the countries. To simplify the presentation, we will assume that if  $t_{ik} = t_{ij} + c$ , country  $k$  exporters will sell in country  $i$  (which minimizes world transaction costs).

It will be assumed that the trade negotiators choose tariffs to maximize a social welfare function. Tariff revenue, consumer welfare, and producer welfare in the export sectors and import-competing sector all receive equal weight. Under this assumption, the national welfare function can be expressed as

$$W^i(t_{12}, t_{13}, t_{21}, t_{23}, t_{31}, t_{32}) = \sum_{j=1}^3 \frac{1}{2} (A - P_j^i)^2 + \sum_{j \neq i} P_j^i x + P_i^i y + \sum_{j \neq i} t_{ij} M_{ij} + x_0. \quad (2)$$

The following lemma summarizes the impact of tariffs on national welfare:

**Lemma 1** *The welfare functions  $W_i$  have the properties:*

*Property (a):  $W_i$  is strictly concave in  $t_{ij}$ , and is increasing in  $t_{ij}$  at  $t_{ij} = t_{ik} = 0$*

*Property (b):  $W_i$  is decreasing in  $t_{ji}$  for  $j \neq i$  and is increasing in  $t_{jk}$  for  $j, k \neq i$  and  $j \neq k$ .*

Part (a) shows that each country will have a positive optimal tariff against the other countries. Part (b) implies that country  $i$  is harmed by being discriminated against in country  $j$ 's market but benefits from being favorably treated in country  $j$ 's market.

In the absence of a trade agreement, the optimal tariff policy for country  $i$  is obtained by choosing  $t_{ij}$  ( $j \neq i$ ) to maximize (2). It is straightforward to show that due to the symmetry between the countries, the optimal tariff policy will have equal tariffs on imports from all partners at a value given by

$$t^N = \frac{x - y - c}{4} \quad \text{for } x - y - c > 0 \quad (3)$$

The restriction on the endowments, which will be maintained throughout the analysis, ensures that the optimal equilibrium tariff is not corner solution, that is, the efficient tariff level. If the restriction is violated, there will be no prisoners' dilemma problem in tariff setting, as will be shown below. Due to the separability of markets and the endowment pattern, the optimal trade policy of country  $i$  is independent of tariffs set by other countries and (3) will be the tariffs in the non-cooperative Nash equilibrium.

If the endowments restriction in (3) is not violated, the welfare functions  $W_i$  reflect the standard prisoner's dilemma problem of trade policy, since all countries would gain by multilateral tariff reductions in the neighborhood of the Nash equilibrium tariff. If countries can commit to tariff rates in negotiations, then the multilateral tariff negotiations involving all three countries can be modeled as a Nash bargaining problem in which the threat point of each country is its Nash equilibrium payoff. The solution to this problem is the tariff vector that maximizes world welfare,  $\sum_{i=1}^3 W^i$ , which yields the solution

$$t_{ij} = t^C = 0$$

That is, free trade is the efficient outcome.

### 3 The Accession Game without MFN

We analyze the accession process by assuming that countries 1 and 2 have an existing trade agreement that specifies the tariffs that they impose on trade with each other. Due to the symmetry of the member countries, we assume that they choose a common tariff  $\bar{t}_{12} = \bar{t}_{21} = t^m$  on trade with each other. We model the accession process as a bargaining game in which the non-member country makes tariff concessions on the tariff it imposes on imports from member countries,  $t_{31}$  and  $t_{32}$ , in return for receiving tariff concessions from the member countries,  $t_{13}$ ,  $t_{23}$ . We allow for the possibility of transfers between the countries in terms of the numeraire good as part of the bargaining process, with  $Z_1$  and  $Z_2$  denoting the transfer made by the acceding country to country 1 and 2 respectively as part of the agreement. With these restrictions on the accession negotiation, the payoff to a representative member country under an agreement will be  $W^1 + Z_1$  and  $W^2 + Z_2$ , where  $W^j \equiv W^j(t_{12}, t_{13}, t_{21}, t_{23}, t_{31}, t_{32})$  where  $j \in \{1, 2\}$ . The payoff to the acceding country will be  $W^a - Z_1 - Z_2$ , where  $W^a \equiv W^3(t_{12}, t_{13}, t_{21}, t_{23}, t_{31}, t_{32})$ .

If an agreement is not reached between the countries, then we assume that the member countries impose  $t^m$  on each other and the optimal discriminatory tariff on imports from the non-member country. We assume that the members do not co-ordinate in setting their respective tariffs against the non-member. Note that since the national welfare functions defined in (2) are separable in tariffs on different goods, the optimal tariff imposed by 1 on 3 is a function of  $t_{12}$  only. Using symmetry, we can express the optimal tariff of the member on non-members as  $t_{i3} = \tilde{t}(t^m)$  for  $i = 1, 2$ . Similarly, this separability implies that the optimal tariff of the non-member on members will be its Nash equilibrium tariff,  $t_N$ , from (3). The payoff to a member and the acceding country in the absence of an agreement can thus be represented respectively by  $W_D^m(t^m) = W^1(t^m, \tilde{t}(t^m), t^m, \tilde{t}(t^m), t^N, t^N) = W^2(t^m, \tilde{t}(t^m), t^m, \tilde{t}(t^m), t^N, t^N)$  and  $W_D^a(t^m) = W^3(t^m, \tilde{t}(t^m), t^m, \tilde{t}(t^m), t^N, t^N)$ . Given the above agreement and threat point payoff functions, the bargaining problem of the accession game can be described as follow. Recall that country 3 is the acceding country, and let  $Z_i$  denote the transfer that country 3 gives to  $i = 1, 2$ . The bargaining game takes the following structure: In Stage I, countries 1 and 3 bargain over  $t_{13}, t_{31}, Z_1$ ; in Stage II, countries 2 and 3 bargain over  $t_{23}, t_{32}, Z_2$ , given  $t_{13}, t_{31}, Z_1$ .

In the following subsection, we try to characterize the solutions of the model. We shall assume that Properties (a) and (b) hold in the rest of the paper.

### 3.1 A Cooperative Sequential Bargaining Model without MFN

Assume that the bargaining powers (or discount rates) of all countries are the same. Without an MFN principle, the *second stage* Nash bargaining problem is

$$\max_{t_{23}, t_{32}, Z_2} \left[ W^2(t_{13}, t_{23}, t_{31}, t_{32}) - W_D^2 + Z_2 \right] \left[ W^3(t_{13}, t_{23}, t_{31}, t_{32}) - W_D^3 - Z_1 - Z_2 \right] \quad (4)$$

given the terms negotiated between 1 and 3 in the first stage as well as the terms negotiated between 1 and 2 in previous negotiations (these terms include  $t_{12}, t_{21}, t_{13}, t_{31}$  and  $Z_1$ , with  $t_{12}, t_{21}$  being suppressed in (4) to simplify the notation). Assume for now that the disagreement payoffs (for  $j = 1, 2, 3$ ) are fixed.

Define country 1's surplus as  $X_1 \equiv W^1 - W_D^1 + Z_1$ ; country 2's surplus as  $X_2 \equiv W^2 - W_D^2 + Z_2$ ; country 3's surplus as  $X_3 \equiv W^3 - W_D^3 - Z_1 - Z_2$ ; The total surplus to be allocated as  $Y \equiv (W^1 - W_D^1) + (W^2 - W_D^2) + (W^3 - W_D^3)$ .

The bargaining problem can in fact be separated into two independent parts. The first part involves bargain over  $t_{13}, t_{23}, t_{31}, t_{32}$ , which determines the total surplus  $Y$ . This is the size of the pie to be divided. The second part involves the bargain over  $Z_1$  and  $Z_2$ , which determines the share of each country in the total surplus. This is the share of the pie. The bargaining over  $Z_1$  and  $Z_2$  amounts to the following:

(I) countries 1 and 3 bargain over  $X_1$

(II) countries 2 and 3 bargain over  $X_2$ , given  $X_1$

Using backward induction, the stage 2 bargaining problem over  $Z_2$  can be expressed as choosing  $X_2$  to maximize  $(Y - X_1 - X_2)X_2$ . This yields the solution  $X_2^* = (Y - X_1)/2$ .

The *first stage* bargaining problem can be written as

$$\max_{t_{13}, t_{31}, Z_1} \left[ W^1(t_{13}, t_{23}(t_{13}), t_{31}, t_{32}(t_{31})) - W_D^1 + Z_1 \right] \times \left[ W^3(t_{13}, t_{23}(t_{13}), t_{31}, t_{32}(t_{31})) - W_D^3 - Z_1 - Z_2(Z_1, t_{13}, t_{31}) \right] \quad (5)$$

The first period bargaining problem over  $Z_1$  is solved by choosing  $X_1$  to maximize  $(Y - X_1 - X_2(X_1))X_1 = 0.5(Y - X_1)X_1$ . This, together with the first order condition for the

second period bargaining problem (over  $Z_1$ ), yields the solutions  $X_1/Y = 1/2$ ,  $X_2/Y = 1/4$ ,  $X_3/Y = 1/4$ . Thus, Country 1 obtains half of the difference between the world payoff under the agreement and the world disagreement payoff. The intuition is that in the first stage bargaining problem without MFN, country 3 takes into account the fact that each additional \$1 it receives from country 1 in the first stage will be split between country 2 and country 3. This implicitly makes country 3 a weak bargainer in stage 1, because the cost of each \$1 it gives up to country 1 is only \$1/2.

We have assumed that, in the event that 3's negotiations fail with either of the member countries, then 3 does not become a member. (In fact, there is a well-known principle that there has to be consensus among all members of the Working Party regarding accession of a country.) In this case the payoffs revert to those in the previous Nash equilibrium (i.e.  $t_{12}$  and  $t_{21}$  are at the prevailing agreement levels and the remaining tariffs are set non-cooperatively in a one shot game). Moreover, the disagreement payoffs are functions only of  $t_{12}$  and  $t_{21}$ , and can be treated as constants as in the above discussion.

## 4 The Accession Game with MFN

As before, due to the symmetry of the member countries, we assume that they choose a common tariff  $\overline{t_{12}} = \overline{t_{21}} = t^m$  on trade with each other. In this case, we model the accession process as a bargaining game in which the non-member country makes tariff concessions on the tariff it imposes on imports from member countries,  $t^a = t_{31} = t_{32}$ , in return for receiving MFN treatment by the member countries,  $t_{13} = t_{23} = t^m$ . As before, we allow for the possibility of transfers between the countries in terms of the numeraire good as part of the bargaining process, with  $Z$  denoting the transfer made by the acceding country to each of the member countries as part of the agreement. [This follows from MFN in transfer as well as the symmetry assumption.] With these restrictions on the accession negotiation, the payoff to a representative member country under an agreement will be  $W^m(t^m, t^a) + Z$ , where  $W^m(t^m, t^a) \equiv W^1(t^m, t^m, t^m, t^m, t^a, t^a)$ . The payoff to the acceding country will be  $W^a(t^m, t^a) - 2Z$ , where  $W^a(t^m, t^a) \equiv W^3(t^m, t^m, t^m, t^m, t^a, t^a)$ .



## 4.1 A Cooperative Sequential Bargaining Model with MFN

There is no need to negotiate over  $t_{13}$  and  $t_{23}$  anymore because of MFN. Given the above agreement and threat point payoff functions, the Nash bargaining solution to the accession game can be described below.

The second stage bargaining problem is

$$\max_{t_{32}, Z_2} \left[ W^2(t_{32}) - W_D^2 + Z_2 \right] \left[ W^3(t_{32}) - W_D^3 - Z_1 - Z_2 \right] \quad (6)$$

subject to the constraints  $t_{32} \leq \overline{t_{31}}$ ;  $t_{32} = t_{31} \equiv t^a$ ;  $Z_2 \geq \overline{Z_1}$ ;  $Z_2 = Z_1 \equiv Z$ . The values of  $\overline{t_{31}}$  and  $\overline{Z_1}$  are the terms negotiated between 1 and 3 in the first stage. The terms  $t_{12}$  and  $t_{21}$  have been negotiated between 1 and 2 in previous negotiations.

The first stage bargaining problem is

$$\max_{t_{31}, Z_1} \left[ W^1(t_{31}, t_{32}(t_{31})) - W_D^1 + Z_1 \right] \left[ W^3(t_{31}, t_{32}(t_{31})) - W_D^3 - Z_1 - Z_2(Z_1) \right] \quad (7)$$

Again, the bargaining can in fact be separated into two independent parts. The first part involves bargain over  $t_{31}, t_{32}$ , which determines the total surplus  $Y$ . The second part involves the bargain over  $Z_1$  and  $Z_2$ , which determines the share of each country in the total surplus. It turns out that, if countries 1 and 2 are symmetrical, the solution to the two stages of negotiation is the same as the solution to

$$\max_{t_{31}, Z_1} \left[ W^1(t_{31}, t_{32}) - W_D^1 + Z_1 \right] \left[ W^3(t_{31}, t_{32}) - W_D^3 - Z_1 - Z_2 \right] \quad (8)$$

subject to  $t_{32} = t_{31}$  and  $Z_1 = Z_2$ . The negotiation over  $Z$  gives rise to

$$X_1 = \frac{W^1 - W_D^1}{2} + \frac{W^3 - W_D^3}{4}$$

$$X_2 = W^1 - W_D^1 - \frac{W^2 - W_D^2}{2} + \frac{W^3 - W_D^3}{4}$$

$$Y - X_1 - X_2 = W^1 - W_D^1 + \frac{W^3 - W_D^3}{2}$$

Since 1 and 2 are symmetrical,  $W^1 - W_D^1 = W^2 - W_D^2$ , from which we can conclude that the shares of country 1, 2 and 3 are respectively 1/4, 1/4 and 1/2. Therefore, MFN leads to greater share of total surplus for the acceding country. The intuition is: When the MFN condition is imposed, the bargaining power is reverse of the case with no MFN because country 3 now views the cost of each \$1 given to country 1 as \$2, since it must also give the \$1 to country 2. This makes country 3 a strong bargainer, and leads to its higher share of surplus.

## 5 Efficiency Properties of the tariffs

For the case with no MFN, define

$$W_j^i \equiv \partial W^i / \partial t_j \text{ where } i \in \{1, 2, 3\} \text{ and } j \in \{12, 21, 13, 31, 23, 32\}.$$

Consider the second stage of the sequential bargain when there is no MFN. Recall that the Nash bargaining problem is

$$\max_{t_{23}, t_{32}, Z_2} \left[ W^2(t_{13}, t_{23}, t_{31}, t_{32}) - W_D^2 + Z_2 \right] \left[ W^3(t_{13}, t_{23}, t_{31}, t_{32}) - W_D^3 - Z_1 - Z_2 \right]$$

Together with the F.O.C. for bargaining over  $Z_2$  from the above maximization problem, the bargain over  $t_{23}, t_{32}$  yields the necessary first order condition for the above problem:

$$W_j^2 + W_j^3 = 0 \text{ for } j \in \{23, 32\}. \quad (9)$$

Since  $W_{23}^1 > 0$ , we have

$$\begin{aligned} W_{23}^1 + W_{23}^2 + W_{23}^3 &> 0 \\ \implies \sum_{j=1}^3 W_{23}^j &> 0 \end{aligned}$$

Because  $\sum_{j=1}^3 W_{23}^j \neq 0$ ,  $t_{23}$  is not efficient. Since  $W_{32}^1 > 0$ , we can similarly conclude that  $t_{32}$  is not efficient. The choice of tariffs in (4) will not be efficient (in the sense that the choices do not maximize world welfare) because the effect of tariffs on country 1 is ignored. One can also infer that  $t_{31}$  and  $t_{13}$  would not be efficient, for the same reason. As a general principle,

countries that negotiate later would ignore the welfare of the earlier negotiators when there is no MFN. As a result of this, the total surplus of the negotiation is not necessarily maximized by the choice of the tariffs.

For the case with MFN, each country is forced to offer the same tariffs to all other countries. This will prevent the later negotiators from ignoring the welfare of the earlier negotiators. Thus, it is conceivable that the tariffs should be more efficient than the case with no MFN if the tariffs between existing members are sufficiently efficient. In particular, China would have incentive to impose efficient tariffs to maximize the total surplus.

## 6 Conclusion/Summary

First, the surplus obtained by China from the WTO accession negotiation is higher than that obtained by the members when MFN principle is applied to tariff concessions as well as other issues in the negotiations (such as intellectual property rights). When the MFN principle is not applied to the negotiations, however, the surplus obtained by the acceding country from the accession negotiations is lower than that of the members. This result is not obvious, since our intuition tells us that China may or may not be disadvantaged by the existence of MFN.

The intuition of the above result is that China takes into account the fact that each additional \$1 it receives from the US in the first stage will be split between China and EU. This implicitly makes China a weak bargainer in its negotiation with the US, because the cost of each \$1 it gives up to the US is only  $\$1/2$ . When the MFN condition is imposed, the bargaining power is reversed because China now views the cost of each \$1 given to the US as \$2, since it must also give the \$1 to the EU. This makes China a strong bargainer, and leads to its higher share of surplus. This intuition is contained in some industrial organization literature. (See, for example, Cooper and Fries 1991 and Horn and Wolinsky 1988.)

Second, the negotiated tariffs are not all efficient. This is because of the existence of many externalities. For example, countries that negotiate later would ignore the welfare of the earlier negotiators. As a result of this, the total surplus of the negotiation is not necessarily maximized by the choice of the tariffs.

Third, there exists early-mover advantage in the no MFN case, in the sense that the earlier a member enters the negotiation, the higher is its surplus gained from the accession

negotiation with the outside country.

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